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INCIDENCE OF SHOULDER PAIN AFTER NECK DISSECTION: A CLINICAL EXPLORATIVE STUDY FOR RISK FACTORS

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Abstract: *Background.* It is the purpose of this study to determine the incidence of shoulder pain and restricted range of motion of the shoulder after neck dissection, and to identify risk factors for the development of shoulder pain and restricted range of motion.

Methods. Clinical patients who underwent a neck dissection completed a questionnaire assessing shoulder pain. The intensity of pain was assessed using a visual analog scale (100 mm). Range of motion of the shoulder was measured. Information about reconstructive surgery and side and type of neck dissection was retrieved from the medical records.

Results. Of the patients (n = 177, mean age 60.3 years [SD, 11.9]) 70% experienced pain in the shoulder. Forward flexion and abduction of the operated side was severely reduced compared to the non-operated side, 21° and 47°, respectively. Non-selective neck dissection was a risk factor for the development of shoulder pain (9.6 mm) and a restricted shoulder abduction (55°). Reconstruction was risk factor for a restricted forward flexion of the shoulder (24.5°).

Conclusions. Shoulder pain after neck dissection is clinically present in 70% of the patients. Non-selective neck dissection is a risk factor for shoulder pain and a restricted abduction. Reconstruction is a risk factor for a restricted forward flexion of the shoulder. *Head Neck Head Neck* **23:** 947–953, 2001.

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The presence of shoulder complaints is a common problem following radical neck dissection. Accordingly, Krause[1] found that 72% of the patients suffered from shoulder complaints, whereas 44% of these patients were disabled due to the severity of these shoulder complaints. Other authors found prevalences of shoulder complaints after radical neck dissection varying from 50 to 100%.[2,3] In general, shoulder complaints after radical neck dissection consist of pain in the neck-shoulder region and a restricted active range of motion of the shoulder girdle. It is assumed that these complaints are based on sacrificing the accessory nerve during the neck dissection, which results in most patients in paralysis of the descending and transverse part of the trapezius muscle.[4] Due to loss of strength of the trapezius muscle the scapula shifts downward and the inferior angle rotates medially, resulting in a downward facing of the glenoid fossa.[5] Due to this shift and downward facing, the active range of motion of forward flexion and abduction of the shoulder girdle is restricted. Additionally, during activities of the arm the scapula cannot be adequately stabilized to the thorax as a result of insufficient muscle strength. The change in position of the scapula and the inadequate stabilization may lead to a mechanical overload of the shoulder causing pain. Several structures of the shoulder girdle, including the gleno-humeral joint, acromio-clavicular joint, sterno-clavicular joint, levator scapula, and rhomboid muscles have been held responsible for shoulder pain.[6,7] Even frozen shoulder and lesions of the brachial plexus have been reported after neck dissection.[8,9]

However, if the accessory nerve is not sacrificed, as in functional or modified neck dissections, shoulder complaints are still reported by 31% to 60% of the subjects.[2,3,10,11] Even after selective neck dissections, shoulder complaints have been reported in approximately 29% to 39% of the patients.[12,13]

Most studies identifying shoulder complaints after neck dissection have been performed after discharge from the hospital, at least a month after surgery, or have been performed retrospectively. Only two studies included patients before discharge from the hospital.[14,15] However, in the study of Leipzig et al,[14] no information is provided about shoulder complaints during the hospital stay. In the study of Nowak et al,[15] only the range of motion of the neck and shoulder was assessed, but shoulder pain was not investigated. Therefore, little is known as to whether complaints are present immediately after the operation or whether they develop after discharge from the hospital.

Another problem is that subjects with shoulder complaints before the neck dissection are not excluded in most studies, except in the study of Carentfelt et al.[16] Therefore, most studies cannot be conclusive with regard to the relationship between cause and effect, ie, neck dissection resulting in shoulder complaints, because the shoulder pain may already be present before the dissection.[17]

The aims of this explorative study were to determine the incidence of shoulder pain and restricted range of motion of the shoulder after neck dissection the day before discharge from the hospital to analyze the effect of shoulder pain on daily activities in the clinical phase and to identify risk factors for the development of shoulder pain and restricted range of motion of the shoulder.

MATERIAL AND METHODS

In this multicenter study seven Dutch hospitals participated: Netherlands Cancer Institute/Antoni van Leeuwenhoek Hospital Amsterdam, University Hospital Groningen, University Hospital Maastricht, University Hospital Rotterdam/Daniel, University Hospital Vrije Universiteit Amsterdam, Haaglanden Medical Center Den Haag, and Rijnstate Hospital Arnhem. Clinical patients who underwent a neck dissection because of a tumor in the head and neck area were assessed by a physical therapist the day before discharge from the hospital.

The assessment consisted of a standardized questionnaire, developed for this study, which was completed by the patient. The questionnaire addressed the following information: hand dominance, the presence of preoperative complaints of the shoulders (operated and/or non-operated side) 3 months prior to the neck dissection, and the presence of shoulder pain at the side of the neck dissection under various circumstances. These circumstances included rest, movements of the shoulder, lying on the shoulder, walking with the arm unsupported, dressing, and washing. In addition, the questionnaire assessed problems while washing, dressing, and reaching forward and the reasons for these problems (ie, shoulder pain, stiffness, and/or loss of strength). Finally, the amount of pain in the shoulder of the operated

side was assessed on a visual analog scale (100 mm).

The following information was retrieved from the medical records: tumor type, localization, staging, type and extent of surgery, type of reconstructive surgery, side and type of neck dissection (radical, modified, with preservation of the accessory nerve, or selective), preoperative radiotherapy, and pain medication (non-opiate, mild opiates, and opiates). When the study proved to be feasible, range of motion of the shoulder (forward flexion, abduction external rotation) was measured by the physical therapist using an inclinometer according to a standardized protocol. The questionnaire and the range of motion measurements became part of the standard discharge procedure.

Inclusion criteria for the study were: a neck dissection for a carcinoma of the head and neck region in one of the participating hospitals, good understanding of the Dutch language, and age 18 years or older. Patients with shoulder complaints (at the side of the operation) within 3 months before the neck dissection were excluded as were patients with an history of mental illness. In this way patients at risk for developing shoulder complaints as a result of the neck dissection were selected.

Of the patients with a bilateral dissection the most painful side was entered in the database. The database was checked for missing data, and the participating institutes were requested to provide the missing data, if available.

Data Analysis. Data analysis in SPSS version 9 and CIA version 2 comprised descriptive statistics, 95% confidence interval calculation, *t* tests for paired data, chi square tests, and product moment correlation (Pearson's *r*). In the univariate analyses risk factors for shoulder pain and restrictions in forward flexion and abduction were identified. In the multivariate analyses, linear regressions (method stepwise forward), the extent of shoulder pain, range of abduction, and forward flexion of the operated side were predicted on the basis of the risk factors identified in the univariate analyses. The risk factors were dissection type, preservation of cervical plexus, reconstruction, gender, and age.

For the analysis of differences in range of motion between the operated and the non-operated side, patients with bilateral dissections as well as patients with shoulder complaints of the non-operated side in the 3-month period before the neck dissection were excluded.

RESULTS

The initial database consisted of 75 women (39%) and 119 men (61%). The mean age of the total group was 60.5 (SD, 12.1) years.

After excluding the patients with shoulder complaints before the neck dissection, a cohort of 177 patients remained, consisting of 68 women (40%) and 103 men (60%) with a mean age of 60.3 (SD, 11.9) years. Gender was not recorded in six patients. Data of range of motion of the shoulder was available of 100 patients, after excluding patients with shoulder complaints before the operation (operated and/or non-operated side) and patients with a bilateral dissection.

Descriptive statistics of the research population, type of tumor, tumor stage, type of dissection, preservation of N. XI and cervical branches, radiotherapy, reconstructive surgery, medication use and days after surgery are summarized in Table 1. Shoulder pain was experienced by 70% of the patients (mean intensity 14 mm, SD 16) (Table 2). The number of situations in which the patient experienced pain was significantly related to the intensity of pain (Pearson's $r = .73$; 95% CI: 0.63 to 0.80). Pain intensity was not significantly related ($r = .032$) to the number of days after surgery. Pain medication was used by 60% of the patients experiencing shoulder pain, whereas 43% of the patients without shoulder pain used pain medication. This difference in percentage was not significant (chi square = 2.77; $p = .096$). In women as well as in men, 70% had shoulder pain. Moving the shoulder and lying on the shoulder were most frequently reported to be painful, 31% and 30% respectively. Forward flexion and abduction of the operated side was significantly reduced compared with the non-operated side, 21° and 47°, respectively (Table 3). Risk factors for shoulder pain were sacrificing the cervical plexus versus preservation of this plexus (relative risk (RR) = 1.7), radical dissection versus selective dissection (RR = 1.5), and modified radical dissection versus selective dissection (RR = 1.4). Risk factors for a restricted abduction were sacrificing the cervical plexus versus preservation of this plexus (RR = 1.7), radical dissection versus selective dissection (RR = 2.3), and modified radical dissection versus selective dissection (RR = 1.8). Risk factors for a restricted forward flexion were: sacrificing the cervical plexus versus preservation of this plexus (RR =

Table 1. Descriptive statistics of the population under study, type stage of tumor, side and type of neck dissection, radiotherapy, reconstructive therapy, medication, and days after surgery.

Variables (number of valid observations)*	Frequency	%
Gender (*n* = 171)		
Females	68	40
Males	103	60
Age in years		
$\bar{x}$ (sd) 60.3 (12)		
Tumor type (*n* = 141)		
Squamous cell carcinoma	109	77
Salivary gland tumor	12	9
Melanoma	5	4
Other types of cancer	15	11†
Tumor stage (*n* = 145)		
T0	6	4
T1	32	22
T2	49	34
T3	29	20
T4	24	17
Tx	5	3
Side of dissection (*n* = 169)		
Dominant side	81	49
Non-dominant	84	48
Bilateral dissection	4	1
Type of dissection (*n* = 169)		
Radical neck dissection	42	25
Modified neck dissection (preserving NXI)	95	56
Selective neck dissection	32	19
Preservation of cervical branches (*n* = 68)		
Yes	44	65
Partial	3	4
No	21	31
Preoperative radiotherapy (*n* = 170)		
Yes	20	12
No	150	88
Reconstructive (*n* = 171)		
Pectoral cutaneous flap	20	12
Radial cutaneous flap	9	5
Other	25	15
No	117	68
Medication (*n* = 167)		
No medication	87	52
Non-opiates (NSAIDs)	59	35
Mild opiates	5	4
Opiates	2	1
Unknown	14	8
Days after surgery		
$\bar{x}$ (sd) 13.2 (10)		
Median [interquartile range] 10 [7–16]		

**Because of missing data the totals of the analyses do not always add up to 177.*
†Due to rounding, the sum of the percentages exceeds 100.

1.8) and reconstructive surgery versus no reconstruction (RR = 1.8) (Table 4).

In the linear regression analysis (multivariate analysis), a non-selective dissections was a risk factor for the development of shoulder pain and restricted shoulder abduction. Reconstruction was a risk factor for restricted forward flexion of the shoulder (Table 5).

DISCUSSION

Following neck dissection, 70% of the patients reported some form of shoulder pain in the clinical phase. The intensity of the pain was not excessive judged from the mean, the median, and interquartile range of the pain score. The intensity of pain was 23 or less in 75% of the patients on a 100-mm VAS. It was striking that only 44% of the patients claimed to have pain during one or more provoking situations/activities, whereas 70% scored shoulder pain more than zero on a VAS. This discrepancy in reporting pain might be explained that patients experience a continuous pain, resulting in a score above 0 on the VAS, which is not aggravated by the activities assessed.

Our clinical finding that 79% of the patients who had a radical neck dissection reported shoulder pain is similar to the percentage reported by Krause[1] in his retrospective study in the post-clinical phase (after discharge from the hospital) (Table 4). It is possible that the shoulder is already overloaded with relative non-strenuous activities in the clinical phase. Of the patients who had been operated with preservation of the N. XI (modified radical) still 65% reported pain (Table 4). This percentage is somewhat higher compared with other studies performed post-clinically.[2,3]

Intensity of shoulder pain was not significantly correlated with the number of post-operative days ($r = .032$). Intensity of the shoulder pain was significantly related ($r = .73$) to the number of activities in which patients experienced shoulder pain, indicating that the shoulder pain influences ADL during hospital stay considerably (53% explained variance).

Range of motion was significantly and considerably affected by neck dissection. The mean difference between the operated and non-operated side was 21° for forward flexion and 47° for abduction. The mean difference in external rotation was significant but small. This indicates that neck dissection has the greatest impact on shoulder abduction. The difference in impact can be explained by the fact that the trapezius muscle is active during abduction, whereas during forward flexion the serratus anterior muscle is active.

The risk factors for shoulder pain, restricted abduction, and restricted forward flexion were entered in regression analyses. In the regression analysis, a selective dissection was the only vari-

Table 2. Frequency and intensity of shoulder pain after neck dissection.

Variables (number of valid observation)	Frequency	%	(95% CI)
Shoulder pain present* (n = 128)			
Yes	89	70	(62% to 78%)
Intensity of shoulder pain			
$\bar{x}$ (sd: range) 14.0 (16: 0–66)			
median [inter quartile range] 8 [0–23]			
Pain in the shoulder (n = 177)			
During rest	30	17	(11% to 22%)
Moving the shoulder	54	31	(24% to 38%)
Lying on the shoulder	49	30	(23% to 37%)
Walking (arm not supported)	20	11	(7% to 16%)
Washing the opposite arm	15	9	(4% to 13%)
Dressing	17	10	(5% to 14%)
Difficulties due to pain, stiffness, or weakness of the shoulder with (n = 177):			
Washing	54	31	(24% to 38%)
Dressing	52	30	(13% to 37%)
Number of situations in which the patients experience shoulder pain (n = 177)			
0	99	56	(49% to 63%)
1	30	17	(11% to 22%)
2	21	12	(7% to 17%)
3	9	5	(3% to 9%)
4	9	5	(3% to 9%)
5	4	2	(1% to 6%)
6	5	3	(1% to 6%)

**Pain was assessed on a 100-mm Visual analoge scale. Presence of pain indicates pain >0 on the VAS. Because of missing data the totals of the analyses do not always add up to 177.*

able contributing significantly to the prediction of shoulder pain. The mean difference in shoulder pain between a patient with a selective dissection and a patient with a non-selective dissection (modified or radical) was 9.6 mm on a 100-mm VAS. Thus, selective dissection is a protective factor for shoulder pain compared to non-selective dissections. Although significant, it must be noted that the strength of the protection is weak. Predicting the abduction of the operated side, again selective dissection was the only variable contributing to the equation. The mean difference in abduction between patients with a selective dissection compared with patients with non-selective dissection (modified or radical) is 55°. Our findings that selective dissection provides protection against shoulder pain and a restricted abduction are in agreement with the findings of post-clinical studies.[2,3,18,19]

In the prediction of the forward flexion of the operated side, reconstruction contributed significantly to the regression equation. Clinically this indicates that a reconstruction reduces forward flexion with approximately 25° on the average, compared with non-reconstructed patients. Probably the extent of surgery, the tunnelling of the pectoralis muscle on the side of the surgery, or pain due to the radialis flap reduces forward flexion. This finding is in agreement of Nowak et al[15] who found that reconstruction using a pectoral

Table 3. Differences in range of motion (in degrees) between operated side and non-operated side and the 95% confidence interval of the differences n = 100).

Range of motion	Operated side		Non-operated side			
	$\bar{x}$	SD	$\bar{x}$	SD	Difference	(95% CI)
Forward flexion	138.4	26.3	159.1	24.8	20.7	(14.7–26.6)
Abduction	99.2	46.6	145.7	35.4	46.5	(37.5–55.6)
External rotation	59.5	17.8	65.1	17.7	5.6	(3.6–7.6)

Table 4. Risk factors for shoulder pain, restricted abduction, and restricted forward flexion.

	Shoulder pain	Restricted abduction	Restricted forward flexion
Cervical plexus preserved			
Yes	57%*	53%*	37%*
No	95%	90%	65%
Reconstructed			
Yes	68%	73%	67%*
No	69%	55%	37%
Radiotherapy			
Yes	88%	63%	50%
No	66%	60%	46%
Dissection			
Radical	79%	84%	58%
Modified radical	75%	66%	49%
Dissection			
Radical	79%*	84%*	58%
Selective	52%	36%	32%
Dissection			
Modified radical	75%*	66%*	49%
Selective	52%	36%	32%

Restricted abduction was defined as: abduction (non-operated side) - abduction (operatede side) ≥20°. Restricted forward flexion was defined as: forward flexion (non-operated side) - forward flexion (operated side) ≥20°.

**Percentages differ significantly from each other (results of chi square tests).*

Note: during the analyses "preservation of some branches of the cervical plexus" was left out because of the small number of subjects.

myo-cutaneous flap reduced range of motion of the cervical spine and forward flexion of the shoulder.[17]

Because of the hospital setting of this study our results can only be generalized to the post-clinical phase to a limited extent. Although the dissection was performed preserving the N. XI, in many subjects, still the only procedure that had a protective effect on shoulder pain was a selective dissection (Table 5). It is possible that during non-selective procedures, but with preservation of the N. XI, the nerve loses its conductive function temporarily due to stripping of the nerve from its surrounding tissues resulting in a neurapraxia. This neurapraxia may recover in the post clinical phase.[18,20]

The type and extent of dissection is dictated by the tumor site, size, and stage. However, when possible, surgery should be as selective as possible to reduce shoulder pain and restriction in abduction. Additionally a modified neck dissection preserving the N. XI in a clinical positive neck does not adversely affect survival and neck control.[21]

A weakness of this study is the considerable amount of missing data, which in part can be attributed to incompleteness of the medical files. For instance, quite often it could not be found in the surgery reports whether the cervical plexus was preserved or not. Even the tumor type was not available in 36 cases.

Strength of this study was that subjects with shoulder complaints prior to the dissection were excluded from the analysis. In a post-hoc analysis, the intensity of pain (VAS score) in the group with complaints before the dissection was 39.1 mm and in the group without complaints 14.0 mm (95% CI of the difference: 10.8 to 39.3). This illustrates the impact on the results of the patients with complaints before the dissection, if they are not excluded.

In conclusion, pain after neck dissection is clinically present in 70% of the patients. A risk factor for development of shoulder pain is a non-selective dissection. The pain has a considerable impact on activities of clinical daily living.

Table 5. Results of the linear regression analysis to predict shoulder pain, range of motion of abduction, and forward flexion of the operated side.

Variable	β	95% CI of β	*R* square
Shoulder pain operated side			
Selective dissection	−9.6	(−19.1 to −0.2)	
Constant	20.1	(14.4 to 25.8)	.06
Abduction operated side			
Selective dissection	55.0	(35.0 to 75.1)	
Constant	76.1	(64.3 to 87.9)	.35
Forward flexion operated side			
Reconstruction	−24.5	(−35.5 to −13.4)	
Constant	148.4	(141.8 to 155.1)	.26

In the regression analyses the following variables were entered step wise forward: selective dissection (yes/no), preservation of the cervical plexus (yes/no), reconstruction (yes/no), gender (male/female), and age in years.

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